

## **REMARKS**

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

### **Specification Amendments**

The specification has been amended on page 11, lines 6-8 (referring to the substitute specification filed September 23, 2008), to clarify that “a closely packed fine particle means a high strength fine particle having low porosity.” Support for this amendment is found both in the originally filed English specification, as well as the verified English translation of the priority document, submitted herewith.

Specifically, page 11, lines 4-6 of the originally filed English specification recites, “...the void ratio of the fine particle may be 10% or less, preferably 5% or less, further preferably in a range of 3 to 5% and more preferably in a range of 1 to 3%”. These ranges clearly indicate that some porosity, i.e., 10% or less, is present in the fine particle.

Additionally, page 19, paragraph [0057] of the enclosed verified English translation of the priority document indicates that “closely packed fine particle means a high strength fine particle having low porosity.” (Emphasis added.)

The specification has been amended to correct an inadvertent error.

### **Request for Acknowledgement of Claim for Foreign Priority**

Applicants note that the Examiner has not yet acknowledged the claim for foreign priority, nor receipt of the priority document. The Notice of Acceptance mailed February 17, 2006 indicates that the priority document was received by the U.S. PTO. Accordingly, the Examiner is respectfully requested to acknowledge Applicants’ claim for foreign priority, as well as receipt of the certified copy of the priority document with the next correspondence.

### **Summary of Telephonic Interview with Examiner**

Applicants wish to thank Examiner McCracken for the courtesies extended to Applicants’ representative during the telephonic interview of February 3, 2010. During the interview, Applicants’ representative discussed the inadvertent discrepancy between the Japanese language

specification and the originally filed English language specification. Applicants' representative also directed the Examiner's attention to the passage on page 11, lines 4-6 of the originally filed English specification, which indicates that the fine particles may have some porosity.

The Examiner indicated that submission of the verified English translation of the priority document, together with a discussion regarding the support in the originally filed English specification, *should* be sufficient to support the desired amendment to the specification.

Applicants appreciate the Examiner's helpful suggestions in this regard.

**Rejection Under 35 U.S.C. § 112, Second Paragraph**

Claims 1-4, 8-13, 15-28, 32-37 and 39-47 are rejected under 35 U.S.C. § 112, second paragraph.

The Examiner indicates that with respect to independent claims 1, 19 and 36, these claims recite "a void ratio of each of the closely packed fine particles." The Examiner asserts that the conventional usage of the term "void ratio" would seem to refer to the empty space in the reactor or the closeness of particles with respect to one another. Additionally, the Examiner indicates that this construction was also argued in previous responses to Office Actions, i.e., the remarks of September 23, 2008. (Applicants note that these remarks were corrected in the paragraph spanning pages 12 and 13 of the response filed May 6, 2009.) The Examiner notes that the claims as currently drafted refer to a void ratio of each catalyst particle.

The Examiner notes that a portion of the substitute specification indicates that a closely fine particle means a fine particle with high strength, which is not porous. However, the Examiner also correctly notes that the very next sentence of the substitute specification implies that the catalysts are in fact porous. The Examiner expresses concern with the conflict between the usual use of the term "void ratio" and Applicants' desired meaning.

As discussed above, Applicants have amended the specification to correct what appears to be a translation error. Specifically, the specification has been amended to clarify that a closely packed fine particle means a high strength fine particle having **low porosity**. Support for this amendment (as discussed above) is found in both the description of the originally filed English specification, as well as the verified English translation of the Japanese priority document,

submitted herewith. Accordingly, the specification supports Applicants' definition of the term "void ratio".

Additionally, the Examiner indicates that claim 15 contains ambiguities, in that it is unclear what order of steps is required. Specifically, the Examiner questions whether the acid wash is followed by a wash of the organic compound solution, or if the organic compound solution is added to the acid prior to washing the nanotubes.

In response to the Examiner's inquiry, Applicants note that the order of the steps is (1) acid treatment, and then (2) treatment by an organic compound solution. In support of this, Applicants refer the Examiner to the five views contained in Figure 25, as well as page 28, line 21 to page 29, line 11 of the substitute specification. (1) Firstly, fine particles 55 with carbon nanofibers grown are recovered to be washed with acidic solution 56 (Figure: 1/5). (2) Subsequently, "an organic compound solution 96" obtained by mixing "an additive 93" having a functional group with high affinity with carbon nanofibers or having a functional group with lipophilic property, and "an organic compound 94" which is liquid at room temperature is added to the acidic solution 56 in which produced carbon nanofibers are dissolved (Figure: 2/5). (3) Then, as illustrated in the insertion in FIG. 25, carbon nanofiber dispersion 95, enclosed by the additive 93, is dispersed in the organic compound solution 96 (Figure: 2/5). (4) Subsequently, the acidic solution 56 and fine particles 50, from which the carbon nanofibers have been peeled off, are removed to an outside to result in the solution of the organic compound 94 only (Figure: 3/5). (5) Organic compound solution including the carbon nanofiber dispersion 95 is heated and the additives 93, which are micelle particles 97 constituted of an aggregation of the additives, and the carbon nanofibers 52 are separated (Figure: 4/5). (6) Thereafter, the additives 93 and the organic solvent 94 are recovered to obtain pure product of the carbon nanofibers 52 (Figure: 5/5).

In view of the above description, Applicants respectfully assert that the language of claim 15 is definite.

Applicants respectfully request that the rejection under 35 U.S.C. § 112, second paragraph be withdrawn.

**Patentability Arguments**

The patentability of the present invention over the disclosures of the references relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

**Rejections Under 35 U.S.C. § 102(b) and § 103(a)**

I. Claims 1-3, 8-11, 13, 19-26, 32-37, 39-41 and 43 are rejected under 35 U.S.C. § 102(b) as being anticipated by Resasco et al. (U.S. 6,413,487) in view of Ergun et al. (*Fluid Flow through Randomly Packed Columns and Fluidized Beds*, Ind. Eng. Chem. 1949; 41(6): 1179-1184).

II. Claim 28 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Ergun, and further in view of Baker (U.S. 5,618,875) to show a state of fact.

III. Claim 28 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Ergun, and further in view of Baker.

IV. Claims 15-18 and 44-47 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Ergun, and further in view of Margrave et al. (U.S. 6,645,455).

V. Claims 12 and 42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Ergun, and further in view of Smalley et al. (U.S. 6,761,870).

VI. Claim 27 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Ergun, and further in view of Yamada et al. (U.S. 5,102,647).

VII. Claims 1-3, 8-11, 13, 19-26, 32-37, 39-41 and 43 are rejected under 35 U.S.C. § 102(b) as being anticipated by Resasco et al. in view of Kim et al. (*Synthesis and Pore Size Control of Cubic Mesoporous Silica SBA-I*, Chem. Mater. 1999; 11: 487-497).

VIII. Claim 28 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Kim, and further in view of Baker to show a state of fact.

IX. Claim 28 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Kim, and further in view of Baker.

X. Claims 15-18 and 44-47 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Kim, and further in view of Margrave et al.

XI. Claims 12 and 42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Kim, and further in view of Smalley et al.

XII. Claim 27 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Resasco et al. and Kim, and further in view of Yamada et al.

Applicants note that rejections I-VI are similar to rejections VII-XII, except that Ergun is relied upon as the secondary reference in the former rejections, while Kim is relied upon as the secondary reference in the latter rejections.

Additionally, in rejections I-VI, the Examiner takes the position that “void ratio” refers to the bed of particles. The Examiner’s basis for this interpretation is the indefiniteness issue discussed in detail above. In view of the amendment to the specification, as well as the discussion provided above, Applicants respectfully assert that this interpretation of “void ratio” is no longer tenable. Accordingly, it is respectfully requested that rejections I-VI be withdrawn.

Regarding rejections VII-XII, Applicants provide the following additional comments.

The presently claimed invention relates to a particulate catalyst used in a fluidizing layer reaction apparatus, **wherein the void ratio of each particle is 10% or less**. By achieving such a constitution, as described at page 12, lines 2 to 9 of the originally filed English specification, since the carbon nanofibers 52 can grow only from a surface of the fine particle, separation of the carbon nanofibers is easy. Please see Fig. 22(a).

On the other hand, if a fine particle having a void ratio of 10% or greater is used, when carbon nanofibers 52 together with the surface of the porous fine particle are peeled off, due to undulation of the porous surface in separation of the carbon nanofibers 52, and the porous fine particle constitutes an impurity, the result is lower purity. Please see Fig. 22(b).

The closely packed fine particle of the presently claimed invention is a support for supporting a catalyst., wherein:

- (1) the void ratio is 10% or less, regardless of the material used for the support, and
- (2) the support is "closely packed", i.e., has a high strength. Please see page 10, line 19 to page 11, line 9 of the originally filed specification.

Feature (1) mentioned above allows the prevention of peeling-off of a part of the surface of the support together with the CNT when physically separating the CNT from the surface of the support. Please see page 11, lines 6-9 of the originally filed specification.

In other words, if the support has **high porosity** (contrary to Applicants' presently claimed invention), a CNT that grows from the inside of the support will be present. Furthermore, a part of the support may be peeled in order to separate the CNT. To address this problem, the presently claimed invention contributes to the prevention of the peeling-off of the support, and the improvement of the yield, by **lowering the void ratio of the support to 10% or less**, and growing CNTs by catalysts on the surface of the support.

The Resasco reference discloses the production of a CNT by supporting a catalyst with a solid support (col. 3, lines 32-45) to grow the CNT, separating the catalyst and the CNT from the support using NaOH (col. 4, lines 42-61), and further performing acid treatment (col. 5, lines 1-7).

Comparing the presently claimed invention with the teachings of Resasco, the reference fails to disclose, or even recognize, the problem which is improved by the presently claimed invention. Specifically, Resasco fails to recognize the problem of peeling off a support when a CNT is separated by a physical action. Accordingly, it follows that Resasco also fails to teach or suggest the solution discovered by Applicants, i.e., lowering the void ratio of each particle, and thus improving peeling off a support due to a physical action.

Furthermore, the Examiner states that Resasco explicitly teaches that variables affect the nanotube/nanofiber yield. The passage relied upon by the Examiner (col. 3, lines 59-64) discloses that the yield of nanotubes is affected by the catalyst formulation (e.g., transition metal ratio, type of support, and metal loading). However, Applicants respectfully assert that these teachings do not teach or suggest *void ratio* as a variable for affecting the nanotube yield.

The Examiner takes the position that optimizing the porosity of the catalyst, when it is a known result-effective variable, does not impart patentability. The Examiner relies on Kim as teaching that control of pore size is well within the skill in the art.

Kim principally discloses a relation between pore size and the adsorption of gas. It would be clear to one of ordinary skill in the art that the technical field of Kim is quite different from that of the presently claimed invention (and of Resasco). Accordingly, one of ordinary skill

in the art would not look to Kim to modify the teachings of Resasco. Specifically, Kim fails to provide any motivation for combining Resasco's method for producing CNTs, which produces CNTs by carrying a catalyst on a fluidizing layer and forming a fluidized bed with more than one catalyst-carrying fluidizing layer, with the teachings of Kim. Further, although the Examiner states that Resasco suggests that control of pore volume affects yield, the only variables discussed by Resasco are transition metal ratio, type of support and metal loading. Absent the teachings of Kim, the Examiner has not provided evidence that the void ratio of each catalyst particle is a known result-effective variable **in this field of art**.

Accordingly, Resasco in view of Kim fails to teach or suggest the limitations of Applicants' claims. The additional references relied upon in the remaining rejections fail to remedy the deficiencies of Resasco and Kim.

In view of the above remarks, Applicants respectfully request that each of the above rejections be withdrawn.

### **Conclusion**

Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

Yuichi FUJIOKA et al.

/Amy E. Schmid/  
2010.02.17 15:57:10 -05'00'  
By \_\_\_\_\_  
Amy E. Schmid  
Registration No. 55,965  
Attorney for Applicants

AES/cbc  
Washington, D.C. 20005-1503  
Telephone (202) 721-8200  
Facsimile (202) 721-8250  
February 17, 2010